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USER'S MANUAL

FREQUENCY CONVERTER

MODEL 13-4618-20 & 13-G4618-20

(S/N 1200 AND ABOVE)

GOULD

Electronics

8-A-6-K

GOULD
Electronics

MANUAL PART NO.
MU 13-4618-20

USER'S MANUAL
FREQUENCY CONVERTER
MODEL 13-4618-20 & 13-G4618-20

(S/N 1200 AND ABOVE)

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Gould Inc., Recording Systems Division
3631 Perkins Avenue, Cleveland, Ohio 44114

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PRINTED IN U.S.A.

SAFETY SUMMARY

The general safety information is for both user and service personnel. Specific **WARNINGS** and **CAUTIONS** will be found throughout the manual where they apply.

TERMS IN THIS MANUAL

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property. They will appear in boldfaced capital letters.

WARNING statements identify conditions or practices that could result in personal injury or loss of life. They will appear in boldfaced capital letters.

SYMBOLS IN THIS MANUAL

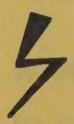
This symbol indicates where cautionary information is to be found.

TERMS AS MARKED ON EQUIPMENT

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property, including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS AS MARKED ON EQUIPMENT



DANGER - High Voltage.

Protective ground (earth) terminal.

ATTENTION - Refer to manual.

POWER SOURCE

This instrument is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential.

GROUNDING THE INSTRUMENT

This instrument is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

USE THE PROPER POWER CORD

Use only the power cord and connector specified for your instrument. Use only a power cord that is in good condition. For detailed information on power cords and connections see Section 2, Installation, in the User's Manual.

USE THE PROPER FUSE

To avoid fire hazard, use only a fuse of the correct type, voltage rating and current rating as specified in the parts list for your instrument.

DO NOT OPERATE WITHOUT COVERS AND PANELS INSTALLED

To avoid personal injury and equipment damage, the user should disconnect power before removing covers, panels or any grounding straps. Reinstall covers, panels, and any grounding straps *before* reconnecting power.

WARNINGS FOR AUTHORIZED SERVICE PERSONNEL

Do not perform internal service or adjustment of this instrument unless another person capable of rendering first aid and resuscitation is present.

Dangerous voltages exist at several points in this instrument. To avoid personal injury, do not touch exposed connections or components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

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WARRANTY

All products manufactured and sold by Gould Inc., Test and Measurement Group are warranted to conform to the applicable published specification in effect at the time of shipment, and to be free from defects in material or manufacture for the applicable period set forth in the table below, when used with recommended Gould associated equipment and/or supplies. If any such product proves defective during the applicable warranty period, Gould, at its option, will either repair the defective product without charge for parts and labor or provide a replacement in exchange for the defective product.

The obligations of Gould or its designated service centers with respect to the provisions of this warranty are expressly limited to the original purchaser and the country of initial purchase unless otherwise agreed and stated in the terms and conditions of any order for products accepted by Gould.

In order to obtain service under this warranty, Buyer must notify Gould or its designated service center of the defect before the expiration of the warranty period and make suitable arrangements for either the return of the defective product or on-site performance of service. Buyer shall be responsible for packaging and shipping the defective product, transportation prepaid, to Gould's designated service center. Gould will provide on-site performance of warranty service only upon prior agreement and subject to payment of an additional charge by Buyer. Warranty work is performed Monday thru Friday, 8:00 a.m. to 5:00 p.m.

Gould reserves the right to determine the cause and existence of a defect under this warranty and this warranty shall not apply to any products which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, inundation, fire or operation outside their published maximum ratings.

Product Category	Warranty Period
Analog & Digital Oscilloscopes	2 YEARS from date of shipment
Logic Analyzers*, Oscillographic Recorders, Strip Chart Recorders, Array Recorders, Waveform Recording Products, DASA Data Acquisition (AT computers), DASA Data Acquisition (Accessories), Analog XY Recorders, Monitor Scopes & Digital Displays, Chart Paper.	1 YEAR from date of shipment
Digital Plotters	6 MONTHS from date of shipment

*Except for disk drive memory storage devices which are warranted for 90 days

GOULD'S LIABILITY UNDER SUCH WARRANTY IS LIMITED TO SERVICING OR REPLACING DEFECTIVE PARTS EXCEPT PENS, STYLI, FUSES, BATTERIES AND CATHODE RAY TUBES, AND DOES NOT INCLUDE CALIBRATION AND MINOR MAINTENANCE AS OUTLINED IN GOULD OPERATING MANUALS. IN NO EVENT SHALL GOULD BE LIABLE UNDER ANY CIRCUMSTANCES, FOR ANY LOSS OF PROFITS OR OTHER CONTINGENT, CONSEQUENTIAL OR SPECIAL DAMAGES. THE FOREGOING WARRANTY IS EXCLUSIVE AND EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS OF ANY OTHER OBLIGATION AND SHALL CONSTITUTE THE SOLE REMEDY OF THE BUYER AND SOLE LIABILITY OF GOULD.

Gould offers an Extended Warranty Agreement for all its products, along with calibration traceable to NBS. Please contact the Service Center listed on the following pages for details before your warranty expires.

REPLACEMENT PARTS: Warranty is same as above except ninety (90) days from date of shipment.

If a defect occurs, notify your nearest Gould Service Center giving full details of the difficulty, and include the product model number, and serial number. On receipt of this information, service data or shipping instructions will be provided.

Compliance with the above procedure will assure the earliest repair and return of your equipment.

Gould instruments are individually tested and calibrated before shipment to assure dependability and verify their accuracy. To this procedure must be added an unseen ingredient of prime importance to you: The Gould concept of continuing service. Gould responsibility for each instrument sold covers far more than its delivery. Of equal concern is the equipment's suitability for its intended purpose, its correct installation, instruction of operating personnel -- plus future servicing and maintenance. The Gould Field Service Department offers customers any or all of these services:

Field Service

- Installation
- Field maintenance
- NBS Certification

Training

- Instruction of operators
- On-site training seminars
- Formal Training courses

Service Contracts

- Fixed Fee
- Time and Material
- Extended Warranty

Our Seal of Pride Gould Inc., Recording Systems Division, and its predecessor organizations tracing back to Charles F. Brush, have been preeminent in instrumentation development since the 1920's. Among Gould's many achievements is a series of the world's best performing, most versatile, and reliable direct writing recording systems.

Today, Gould recorders and signal conditioners are the overwhelming choice for recording analog signals in the most critical industrial, scientific, and biophysical measurement applications. Whether recording the faintest life signals of a patient in a hospital operating room or the most critical variables in the lab or on the production line, you can depend on the accuracy, faithfulness, clarity, and permanence of the traces made by Gould recorder.

Innovative design, coupled with highest quality, are hallmarks of all Gould products.

The Field Service Engineer Gould field service engineers provide on-the-spot assistance whenever and wherever it is required. While every field service engineer is the product of intensive and thorough factory training, you will find that his greatest strength evolves from field experience and his knowledge of your objectives. He is aware of your problems, is willing and able to assist you in their solution, and is backed by the nation's most experienced organization in recording instrumentation.

Our field service engineers and technicians are daily engaged in the installation, testing, maintenance, repair and inspection of Gould recording systems all over the country. They can provide you with any information about our instruments you may require; if not, they will find the answer to your problem.

Overhaul and Repair Because we service only our own products, our customers can feel confident of prompt, effective results when they turn to Gould Factory Service Centers.

The repair service these centers provide is of particular appeal to those companies that do not operate an instruments repair facility of their own. By designating the nearest Gould Service Center as its maintenance depot, a Gould-equipped company is assured the best chance for continuity of recording instrumentation.

Many companies with their own repair facilities find it more convenient and more truly economical to have their Gould equipment repaired by service contract with the closest Service Center. In addition to enjoying fast turn-around, these companies are spared the expense of carrying an inventory of recorder parts, accessories, and supplies.

Calibration and Certification A small, quiet room in the Standards and Calibration Section at the Gould plant in Cleveland contains precision reference standards just one step removed from the prime reference measurement standards of the United States -- at the National Bureau of Standards in Washington. Included in this room, which is temperature-controlled within one degree and has a constant relative humidity of 40%, are standards for voltage, frequency (derived from the atomic vibration of caesium), resistance, capacitance -- in fact all basic parameters of electrical measurement. The room is maintained under stabilized conditions 365 days a year.

The calibration practice of all Gould Service Centers is directly traceable to the National Bureau of Standards. We can supply complete calibration for any Gould equipment, and we can also certify to manufacturer's specifications followed by a letter of certification when required.

Training The Gould field service engineer will hold short training courses either on the job or at his facility. On-the-job training is usually a brief, informal session with the people who will actually be operating the Gould equipment.

Formal classroom training is more complete: detailed information, a thorough review of underlying theory, training devices, demonstration of problem solving and examination of students to determine their understanding and proficiency is accomplished at our Cleveland plant.

Contracts Customer companies requiring temporary or permanent service are afforded contract arrangements by which agreed-upon maintenance, repair, upgrading and calibration services are performed on a routine basis. Service contracts are now in effect with a number of customers, affording substantial saving in time and money.

Owing to the various requirements of each customer, we do not reproduce here a standard boilerplate agreement -- which might contain too much or too little. Instead, we tailor each contract to a particular customer's needs. This practice has singlehandedly produced substantial savings in time and money for others, and it can do the same for you.

An extended warranty is available at the point of sale allowing a regulated budget for the first two years of ownership. You may take advantage of this warranty within the first year of ownership at a percentage of the current listed price.

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

Gould Frequency Converter, Model 13-4618-20, is a fully input-isolated converter which produces 0 to 5 vdc voltage proportional to an input signal frequency sensed on the input. It is designed to send any input frequency from 0 to 50KHz at a signal level of 10mvrms to 500Vrms. An input offset control adjusts the minimum input trigger level from 0 to ±1vdc to insure that TTL signals across zero and are sensed by the converter. A second input circuit is provided to enable use of an externally located optical coupler. An LED drive current of approximately 50ma is available at the input connector. When this auxiliary input is used, terminals 1 and 3 of J-101 are simply shorted together.

Calibrated controls allow the output voltage to represent any of nine preset ranges from 1 Hz full scale to 50KHz full scale. By utilizing zero suppression and range expansion features, it is possible to represent a portion of the selected range and display it across the full output range. This is fully explained in the section in Operation in this manual.

In addition to calibrated operation described above, a variable sensitivity feature enables the converter full scale output to represent any desired frequency within 40% to 100% of indicated range of the Converter. Refer to Operation section.

This signal conditioner is designed for use with any 2000 Series Recorder or other recording device with 100Kohm input impedance. Frequency Converter can be mounted in a Gould Preamplifier Frame, Carrying Case or preamplifier slot in a 2000 Series Recorder. Operating voltages required are ±15vdc and 12.6vrms.

FIGURE 1-1 FREQUENCY CONVERTER

1.2 SPECIFICATIONS

a. Physical Characteristics

Dimensions: ..... 6.09" High x 10.88" long x 2.18" wide (15.3cm x 28cm x 5.6cm)

Weight: ..... 3.08 lbs. (1.4Kg)

Mounting ..... Retained from rear

Finish ..... Molded front panel — light parchment

b. Converter Input

Input No. 1

Configuration ..... Single ended floating (1500 volt isolation to Chassis)

Impedance ..... 100K ohm ±1%

Input Voltage ..... 10mv rms to 500V rms (Automatic Range)
±10mv trigger level

Maximum Safe Voltage ..... 700 volts peak A.C. or D.C.

Frequency Input ..... 0 to 50KHz.

Input Offset Voltage ..... ±1V front panel adjustable.

Input No. 2

Configuration ..... For use with optical couplers.

Available Led Current ..... 12 volts @ 50ma ±10% short circuit current.

Current Sink Requirement ..... 0.12 ma ±10%

Frequency Response ..... Compatible with optical coupler.

c. Converter Output

Configuration ..... Single ended to common

Output Voltage ..... 0 to 5Vdc

Output Impedance ..... Less than 5 ohms

Calibration Inaccuracy ..... ±.1% of full scale on X1 range

Range Inaccuracy ..... ±.2%

Linearity ..... **Calibrated, within .1% of full scale**
Uncalibrated, within 1% of full scale

Instability (15 Min. Warmup) Ref. to X1 range.

	Zero	Gain
Time:	±.02% FS/24 Hr.	±.02%/24 Hr.
Temp:	±.02% FS/°C	±.08%/°C
Line Change (±10%):	±.10% FS	±.01% reading

Rise Time (10% to 90% Full Scale, < 2% overshoot) ..... .1, .2 and .5 KHz < 200ms
1, 2 and 5 KHz < 20ms
10, 20 and 50KHz < 2ms

Zero Suppression ..... 0 to 100%

Non-Linearity ..... ±.5% of F.S.

Common Mode Rejection (60Hz @ 1 Kohm imbalance) ..... 80db at 60Hz

Noise (10% Signal) ..... <.1% on X1 Range

NOTE: SPECS DO NOT APPLY BELOW 10% OF F.S. SETTING.

d. Controls and Connectors

1) Front Panel

KHz Full Scale Switch	10 position 1, 2, 5 sequence to 50KHz and Off.
Zero Suppression Switch	ON/OFF activates zero suppression control.
Zero Suppression Control	10 Turn pot 0 to 100% suppression
Input Offset Switch	ON/OFF activates offset control
Sensitivity Control	1 turn pot reduces output by 60%
Range Switch	7 Position multiplies F.S. range.*

2) Internal Controls

Output Zero	Adjusts output to zero in off position
Offset Zero	Adjusts 10% F.S. Signal to ±.5V dc
Gain	Adjusts 100% F.S. signal to +5.0V dc
Damping	Adjust rise time for critical damping
Symmetry	Adjust rise & fall time to be equal
Noise	Balances Loop for minimum noise

3) Rear Panel Connectors

Inputs	Guarded Multipin connector Model 11-5407-03
Output and Power	16 Pin card edge connector

e. Environment

Temperature Storage	-40 to 70°C
Operating	0 to 50°C
Humidity (Non-Condensing) 95% relative Humidity	0 to 30°C
Vibration and Shock	Best Commercial Practice

f. Power Requirements

DC Voltage	±15 volts ±.5 volts @ .1A
AC Voltage	12.6V rms @ .2A

* NOTE: This control is intended for use with Zero Suppression. Unit specifications do not apply for input frequencies below 10% of the setting of the KHz FULL SCALE switch, regardless of the RANGE switch setting. This means that with a RANGE switch setting of 0.1 and no Zero Suppression, all displayed readings could exceed tolerances.

g. System Specifications

Gain Accuracy ..... ±.3%

Non-Linearity ..... ±.45%

Instability

	Zero	Gain
Time:	±.12% FS/24 Hr.	±.12%/24 Hr.
Temp:	±.045% FS/°C	±.13%/°C
±10% Line Change:	±.2% FS	±.51%

Rise Time ..... See Converter Specifications

Noise ..... <5mv on X1 Range

SECTION II

INSTALLATION

2.1 GENERAL

This section describes inspection checks to be made upon receipt of Gould Frequency Converter, Model 13-4618-20 with a 2000 Series Recorder. It covers installation procedures, signal and power connections and dimensions.

2.2 INITIAL INSPECTION

Prior to attempting any electrical connections or operation visually examine the unit for broken or loose knobs, dented or nicked panels and broken or chipped rear connectors.

2.3 INSTALLATION

Preamplifier Model 13-4618-20 may be mounted in Gould 2000 Recorder frames, or mounted separately in a Gould rack adapter kit or portable carrying case.

a. Insertion

To install the preamplifier into its appropriate slot:

1. Slide the preamplifier into the enclosure until the rear output card edge connector is engaged.

2. Tighten the rear retaining screw. This locks the preamplifier into the enclosure.

3. Connect the plastic input signal connector and secure it by turning the threaded plastic locking ring clockwise.

b. Removal

1. Disconnect the input connections with a counterclockwise turn and pull.

2. Loosen the rear retaining screw. The preamplifier will move forward about 1/8 of an inch.

3. Carefully slide the entire preamplifier out of the Gould 2000 enclosure.

2.4 SIGNAL CONNECTIONS

This converter has a single ended floating input. Input and output are isolated from chassis, as well as from each other. Two options are available for input signal connections: using the internal optical isolation circuit or making connection to a customer furnished external optical isolator.

a. Internal Optical Coupler

Using a good two conductor shielded cable, connect signal leads to pins 1 and 2 of P-101 (Model 11-5407-03), furnished with unit. Cable shield should be soldered to shell around pins 1 and 2. Pins 6 and 7 of P-101 must be shorted together. See Figure 2-2.

b. External Optical Coupler

Provision is made for use of an external optical coupler. When using this input, pins 1 and 3 of J-101 must be shorted together. Pins 4 & 5 of J-101 supply approximately 50ma drive current to energize the optical coupler diode. Pins 6 and 7 of J-101 are connected to the light sensitive transistor of the coupler. Note that pin 6 is negative with respect to pin 7 and pin 5 is negative with respect to pin 4. See Figure 2-3.

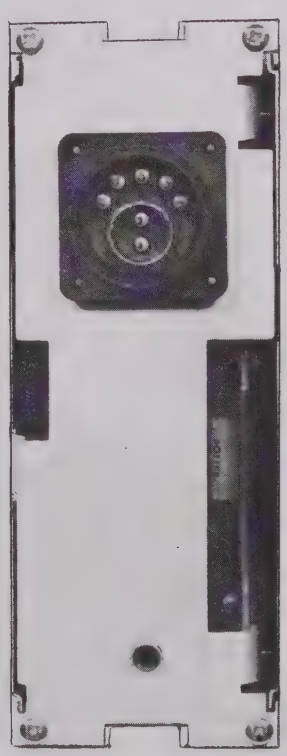

FIGURE 2-1 REAR VIEW

c. Output and Power

The amplifier is designed to operate on + and -15 volt 100ma regulated supplies, and 13vrms, 60Hz sine wave at 200 ma current. Output and power connections are provided through an 8 pin card edge connector on the rear of the preamp. (Figure 2-1). The mating connector is located in the recorder chassis.

The preamplifier provides a 5 volt full scale signal to the recorder.

2.5 OUTLINE DIMENSIONS

Refer to Figure 2-4 for outline dimensions.

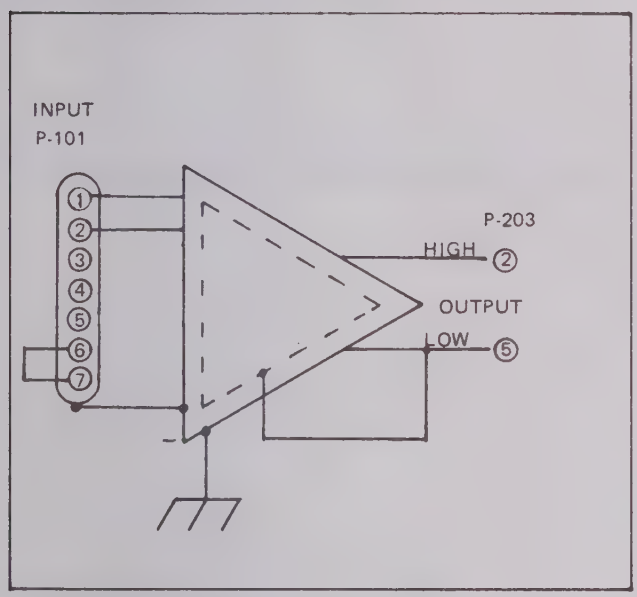

FIGURE 2-2 INTERNAL COUPLER SIGNAL CONNECTIONS

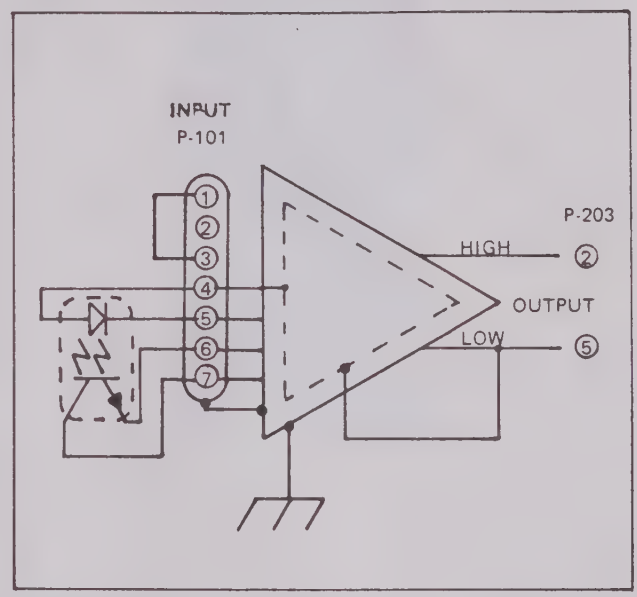

FIGURE 2-3 EXTERNAL COUPLER SIGNAL CONNECTIONS

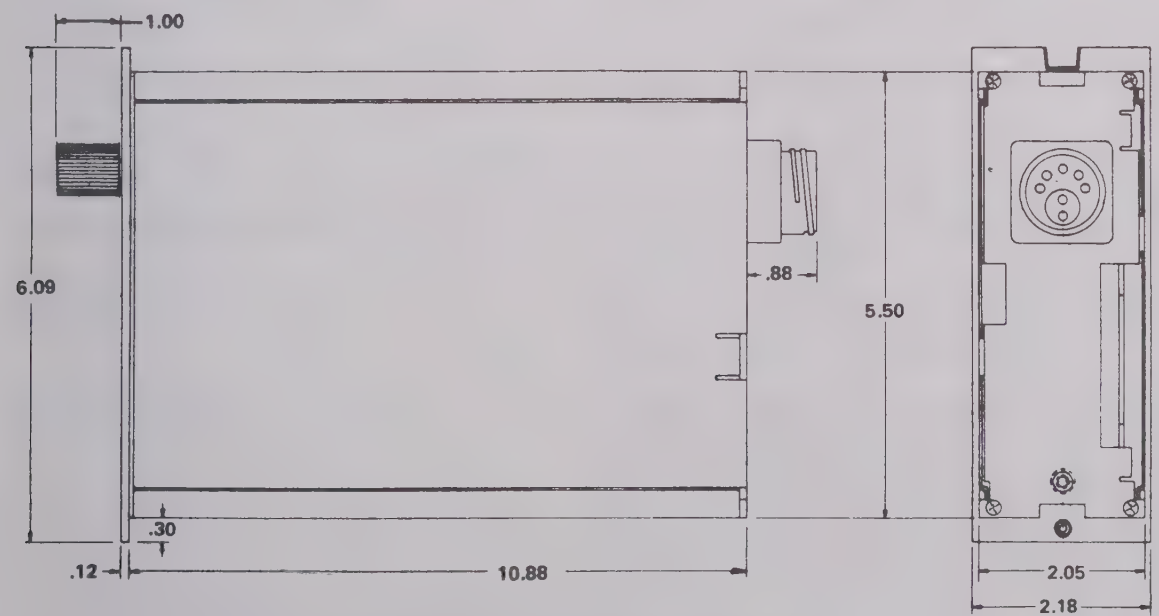

FIGURE 2-4 OUTLINE DIMENSIONS

SECTION III

OPERATION

3.1 GENERAL

This section describes and illustrates the controls of the Gould Model 13-4618-20 Frequency Converter and provides instructions for proper operation. Before attempting to use the amplifier it is imperative that the operator completely understand the functioning of the controls and the required input/output specifications.

3.2 FRONT PANEL CONTROLS

The items listed below correspond to controls shown in Figure 3-1.

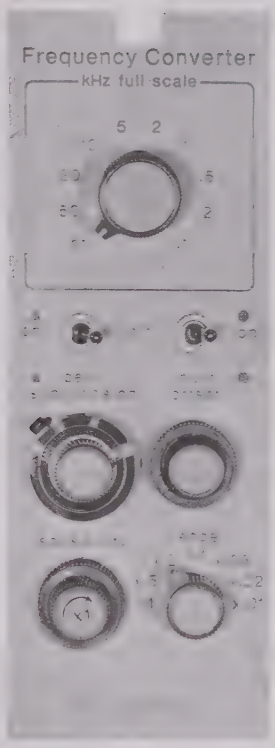

FIGURE 3-1 FRONT PANEL

CONTROL	DESCRIPTION
KHz Full Scale Switch (S-201)	Determines what input frequency will yield a full scale (5V output). Any frequency below that is given as a proportion of the full scale output.
Zero Suppression Switch (S-102)	On-Off switch activates zero suppression control.
Zero Suppression Control (R-103)	Calibrated control which suppresses from 0% to 100% of output signal.
Input Offset Switch (S-101)	On-Off switch activates input offset control.
Input Offset Control (R-102)	Single turn control which adjusts minimum trigger level from 0 to ±1vdc.
Sensitivity Control (R-104)	When fully clockwise, output is calibrated. In other positions, attenuates output up to 60%.
Range Switch (S-103)	Allows expansion of the selected Full Scale Frequency in conjunction with the Zero Suppression controls S-102 and R-103. E.g., a 5 KHz center frequency with ±100 Hz range: Set the KHz Full Scale to 10. Range to x.02. (KHz FS [10] x Range [.02] = 200 Hz). Therefore 4.9 KHz is the low scale end. This is 49.5% of the KHz FS or Dial 4.95. (Turn S-102 ON.) See note on page 1.3.

3.3 OPERATION

CAUTION: ALL PROCEDURES OUTLINED IN SECTION II, INSTALLATION SHOULD BE COMPLETE BEFORE ATTEMPTING OPERATION OF THIS UNIT.

a. General

Before applying any signals to the input of this amplifier, set RANGE switch to the X1 position. With the KHz Full Scale switch in the OFF position, set the recorder pen position to right chart edge.

Move the Full Scale switch to the most sensitive position which still displays the entire output (i.e., does not cause the output to go offscale). NOTE: Frequencies below 10% of the KHz FULL SCALE switch setting may be noisy and erratic.

b. Zero Suppression and Expanded Range

To use calibrated zero suppression, follow step a., above. Next note frequency applied and turn Zero Suppression switch ON. Rotate vernier control clockwise to suppress all but 5% of signal output. Placing RANGE switch to a lower setting will amplify the remaining signal and increase resolution.

EXAMPLE: Input frequency is 16 KHz and can vary between 15 KHz and 17 KHz. With KHz FULL SCALE to the 20 position and Zero Suppression OFF, pen will deflect 80% left of right edge. Calculating what percentage of full scale 15 KHz (the lowest frequency possible) is, it is found to be 75%. Turn zero suppression ON and dial in 7.50 on the vernier control. This moves the 16 KHz center frequency to 5% of full scale. The variation around this frequency is still $\pm$1 KHz. Now, move the RANGE Switch from X1 to X.1. The KHz full scale is now (20KHz) (.1) = 2 KHz. The 16 KHz center frequency moves from 5% of full scale to 50% full scale and the $\pm$1 KHz variation will cause deflection to left chart edge for +1 KHz (17 KHz) or right chart edge for -1 KHz (15 KHz).

c. Input Offset

This converter senses the input frequency for the occurrence of a zero crossing in a positve direction. If the input comes close but does not cross zero, an input offset control is provided to bias the input +1 vdc and insure that the signal then crosses zero. If the input is no closer than 1 vdc off-ground, the converter will not sense the signal. It is not necessary that the input be symmetrical about zero, only that it cross zero at some point in the waveform.

d. Variable Sensitivity

In addition to the calibrated mode of operation previously described, it is possible to operate this unit for a full scale output of any frequency within the operating range of the converter.

EXAMPLE: It is desired to measure frequencies between 0 KHz and 6 KHz. Rather than using 10 KHz Full Scale setting, which would utilize only 60% of full scale, place Frequency Full Scale switch to 5 KHz position. Rotate SENSITIVITY potentiometer CCW until known input (6 KHz) places pen on left chart edge. Now the entire chart is utilized and a 50% full scale reading equals 3 KHz input, 25% reading equals 1.5KHz, etc. Zero Suppression and Range Expansion features can still be used, but keep in mind that calibration factors are now referenced to a 6 KHz Full Scale limit and not 5 KHz Full Scale, as indicated. After tests are completed, place Sensitivity control back to X1 (detent) position to avoid misleading indications when the Frequency Converter is next used.

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